

# **SIGNIFICANCE OF COST EFFECTIVENESS ANALYSIS AND COST BENEFIT ANALYSIS IN INFRASTRUCTURE DEVELOPMENT COMPANY**

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## **ABSTRACT**

*Most often cost-effectiveness and cost-benefit studies are conducted at a level that involves more than just a local program (such as an individual State Strengthening project). Sometimes they also involve following up over a long period of time, to look at the long-term impact of interventions. They are often used by policy analysts and legislators to make broad policy decisions, so they might look at a large federal program, or compare several smaller pilot programs that take different approaches to solving the same social problem. People often use the terms interchangeably, but there are important differences between them. Cost - Effectiveness analysis assumes that a certain benefit or outcome is desired, and that there are several alternative ways to achieve it. The basic question asked is, "Which of these alternatives is the cheapest or most efficient way to get this benefit?" By definition, cost-effectiveness analysis is comparative, while cost-benefit analysis usually considers only one program at a time. Another important difference is that while cost-benefit analysis always compares the monetary costs and benefits of a program, cost-effectiveness studies often compare programs on the basis of some other common scale for measuring outcomes (eg., number of students who graduate from high school, infant mortality rate, test scores that meet a certain level, reports of child abuse). The Cost-Benefit Analysis denotes a methodology for a project evaluation and also a fundamental concept on economic matters. In this respect, the present article reviews some plain concepts which, if misjudged, may lead to assign an economic meaning to usual results having a strictly financial scope. Lying on this premise, the conclusion focuses on the needing for broader categories to evaluate the economic cost-benefit relationships of an investment project. The analysis of the Benefits and Costs of a project aims to evaluate the economic rationality of a possible investment decision. Regarding this, a review on the meaning of that singular methodology known as the "cost-benefit analysis", CBA, here is proposed based on the premise that it focuses on a narrow definition of the economic matter. The CBA provides an accurate conceptual ground to assess business decisions in a market economy, where the production initiatives are assumed at their entrepreneurs' risk. That foundation goes*

*beyond the particular way in which the analysis is performed, pursuing to know whether it can be expected an investment will have a value higher than its cost. Would the latter situation hold, the difference between both amounts will be granted as an extraordinary retribution to the entrepreneurial initiative? On this subject, a simple model explains how that differential of values comes into evidence when the financial principles of valuation get differentiated from those economic outcomes submitted to evaluation. Conversely, the extension of the above mentioned principle to the field of wider economic and environmental evaluations does not seem to have the same accurate meaning, because it pays attention only to a partial matter. What argued is the need to enlarge the categories and approach of the analysis when evaluating, for the society as a whole, the economic performance of a project and the economic consequences derived from environmental matters (and in any other case where to deal with the long run was required). In item I the CBA methodology will be described by means of a formal analysis, to settle an interpretation over its meaning and scope. Next, in item II, the answer previously obtained will be analyzed in terms of its adequacy for a private business under the context of a monetary economy. The third item will describe those restrictions observed on the CBA applicability for business and on its economic meaning either for society or for an environmental issue. Finally, item IV proposes some reflection lines to address an analysis regarding the economic evaluation of an investment project. This paper reveals cost allocation, cost effectiveness analysis, cost benefit analysis, theoretical view of Cost Effectiveness Analysis and cost Benefit Analysis.*

**Key words:** Cost Allocation, **Cost Effectiveness analysis, Cost Benefit Analysis,** Theoretical view of Cost Effectiveness Analysis and cost Benefit Analysis.

**Cite this Article:** Dr. J.S.V.Gopala Sarma, Significance of Cost Effectiveness Analysis and Cost Benefit Analysis In Infrastructure Development Company. *International Journal of Management*, 8(2), 2017, pp. 237–245.

<http://www.iaeme.com/IJM/issues.asp?JType=IJM&VType=8&IType=2>

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## INTRODUCTION

**Cost analysis** (also called **economic evaluation, cost allocation, efficiency assessment, cost-benefit analysis, or cost-effectiveness analysis** by different authors) is currently a somewhat controversial set of methods in program evaluation. One reason for the controversy is that these terms cover a wide range of methods, but are often used interchangeably. At the most basic level, **cost allocation** is simply part of good program budgeting and accounting practices, which allow managers to determine the true cost of providing a given unit of service (Kettner, Moroney, & Martin, 1990). At the most ambitious level, well-publicized **cost-benefit** studies of early intervention programs have claimed to show substantial long-term social gains for participants and cost savings for the public (Berreuta-Clement, Schweinhart, Barnett, et al., 1984). Because these studies have been widely cited and credited with convincing legislators to increase their support for early childhood programs, some practitioners advocate making more use of cost-benefit analysis in evaluating social programs (Barnett, 1988, 1993). Others have cautioned that good cost-benefit or cost-effectiveness studies are complex, require very sophisticated technical skills and training in methodology and in principles of economics, and should not be undertaken lightly (White, 1988). Whatever position you take in this controversy, it is a good idea for program evaluators to have some understanding of the concepts involved, because the cost and effort involved in producing change is a concern in most impact evaluations (Rossi & Freeman, 1993).

## CLASSIFICATION OF COST ANALYSIS

Cost analysis may be classified into three categories in evaluation. They are

- Cost Allocation
- Cost - Effectiveness analysis
- Cost - Benefit analysis

### 1. COST ALLOCATION

Cost allocation is a simpler concept than either cost-benefit analysis or cost-effectiveness analysis. At the program or agency level, it basically means setting up budgeting and accounting systems in a way that allows program managers to determine a **unit cost** or **cost per unit of service**. This information is primarily a management tool. However, if the units measured are also outcomes of interest to evaluators, cost allocation provides some of the basic information needed to conduct more ambitious cost analyses such as cost-benefit analysis or cost-effectiveness analysis. For example, for evaluation purposes, you might want to know the average cost per child of providing an after-school tutoring program, including the costs of staff salaries, snacks, and other overhead costs. Besides budget information, being able to determine unit costs means that you need to be collecting the right kind of information about clients and outcomes. In many agencies, the information recorded in service records is based on reporting requirements, which are not always in a form that is useful for evaluation.

### 2. COST - EFFECTIVENESS ANALYSIS

Most often, cost-effectiveness and cost-benefit studies are conducted at a level that involves more than just a local program (such as an individual State Strengthening project). Sometimes they also involve following up over a long period of time, to look at the long-term impact of interventions. They are often used by policy analysts and legislators to make broad policy decisions, so they might look at a large federal program, or compare several smaller pilot programs that take different approaches to solving the same social problem. People often use the terms interchangeably, but there are important differences between them. Cost - Effectiveness analysis assumes that a certain benefit or outcome is desired, and that there are several alternative ways to achieve it. The basic question asked is, "**Which of these alternatives is the cheapest or most efficient way to get this benefit?**" By definition, cost-effectiveness analysis is comparative, while cost-benefit analysis usually considers only one program at a time. Another important difference is that while cost-benefit analysis always compares the monetary costs and benefits of a program, cost-effectiveness studies often compare programs on the basis of some other common scale for measuring outcomes (eg., number of students who graduate from high school, infant mortality rate, test scores that meet a certain level, reports of child abuse). They address whether the **unit cost** is greater for one program or approach than another, which is often much easier to do, and more informative, than assigning and **how to budget & allocate costs for cost effectiveness studies**:

The type of budgeting and accounting system your program or agency uses may well determine how much useful cost data is available for evaluating your program, or comparing it to others. Three major types of budgeting formats commonly used in social service programs will provide different types and amounts of information (Kettner, Moroney, & Martin, 1990). The most common format is the **Line-Item Budget** format, which simply looks at revenues (money coming in from various sources, including grants, user fees or United Way funds) and expenditures (costs broken down into broad categories like salaries, rent, utilities, and postage), and tries to ensure that they balance. The main purpose of a line-item budget is financial control, and the categories are usually too broad to give much information about the cost of providing

a particular service or obtaining a particular result. The **Functional Budget** format starts with a line-item budget, and takes it a step further. It focuses on process, or the cost of providing a service. For example, with a Functional Budget, we could determine that it cost an adoption agency \$45,000 to conduct 100 home studies (an activity which is a necessary part of the process of placing children in permanent homes). The **Program Budget**, which also starts with a line-item budget, looks at the same information from the point of view of outcomes, or the cost of achieving a result. For example, if the 100 home studies resulted in actually placing 50 children in adoptive homes, the Program Budget would allow us to say that it cost the agency \$45,000 to place 50 children, which is an outcome. Another way to look at this is that functional budgets measure productivity and program budgets measure the cost of achieving goals and objectives.

### 3. COST - BENEFIT ANALYSIS

The basic questions asked in a cost-benefit analysis are, "**Do the economic benefits of providing this service outweigh the economic costs**" and "**Is it worth doing at all**"? One important tool of cost-benefit analysis is the **benefit-to-costs ratio**, which is the total monetary cost of the benefits or outcomes divided by the total monetary costs of obtaining them. Another tool for comparison in cost-benefit analysis is the **net rate of return**, which is basically total costs minus the total value of benefits. The idea behind cost-benefit analysis is simple: if all inputs and outcomes of a proposed alternative can be reduced to a common unit of impact (namely dollars), they can be aggregated and compared. If people would be willing to pay dollars to have something, presumably it is a benefit; if they would pay to avoid it, it is a cost. In practice, however, assigning monetary values to inputs and outcomes in social programs is rarely so simple, and it is not always appropriate to do so (Weimer & Vining, 1992; Thompson, 1982; Zeckhauser, 1975). **An example will illustrate some of the differences between Cost-Effectiveness and Cost-Benefit studies, what they can tell you, and some of the issues that neither can effectively address:**

"Suppose the drop-out rate in an inner-city high school is 50%. Prevention Program A enrolls 20 students, costs \$20,000, and 15 of the 20 students (75%) graduate. Thus Program A resulted in 5 additional graduates at a cost of \$20,000, or one additional graduate for every \$4,000. Prevention Program B enrolls 20 students, costs \$15,000, and 12 of the 20 students (60%) graduate. Thus Program B resulted in 2 additional graduates at a cost of \$15,000, or one additional graduate for every \$7,500 spent. Although Program B is cheaper (\$15,000 compared to \$20,000), Program A is more **Cost effective** (\$4,000/each additional graduate, compared to \$7,500/additional graduate). A **cost-benefit analysis** in this situation, instead of comparing unit costs, would require estimating the dollar value of high school graduation (for example, by projecting the difference in lifetime earning capacity of graduates over drop-outs, and lifetime social service costs), and comparing the monetary value of producing more graduates to the monetary cost of providing the program in the first place. **Neither method effectively addresses more intangible outcomes of graduation, such as increased self-esteem, or the value of a peer support system.**" (White, 1988, p. 430)

### 4. HOW TO CONDUCT A COST - BENEFIT ANALYSIS

Cost-benefit analysis is by far the most complex and controversial of the three methods of costs analysis we have discussed. It should not be attempted by those who lack technical expertise in this area. However, for some purposes, it is also one of the most powerful methods. For those who decide to undertake a cost-benefit analysis in spite of the difficulties, Barnett (1993) outlines a nine step process. Various standard texts are recommended for more in-depth information (see below).

- **Step 1: Define the Scope or Perspective of the Analysis** - The first step is to describe the alternative(s) to be evaluated, and determine whose perspective will guide the evaluation. A narrow cost analysis might look only at the monetary costs and benefits to the individual participant or target of services, or to a particular funder or agency. A broader perspective might attempt to look at a wide range of costs and consequences (intended and unintended, direct and indirect) for society as a whole. A program that is not cost-effective from the perspective of a particular agency within its limited mission and budget may well be cost-effective from the perspective of society, because it saves expenses or prevents problems in other areas. Rossi and Freeman (1993) note that because different stakeholders may have different values and a priority, mixing different viewpoints is likely to result in "confused specifications and overlapping or double counting." Whether we like it or not, the perspective chosen for cost evaluation may have political implications. Therefore, while there are limitations to any one perspective, it is important for the evaluator to clearly state his or her position.
- **Step 2: Conduct Cost Analysis** - The next step is to identify and estimate the monetary value of all resources used in the intervention, not just the budgetary costs. Some costs, such as salaries of direct service staff, rental of office space, or program supplies, are obvious and simple to determine.
- **Step 3: Estimate Program Effects** - This is where more traditional impact or outcome evaluation methods come in. As noted earlier, if we don't know that there is a significant beneficial effect of our program, there is little point in asking how much it costs to get the effect, or whether it is more cost-effective than another kind of program. Many texts on evaluation can assist you in designing a valid evaluation (Rossi & Freeman, 1993; State Strengthening Evaluation Guide, 1997). Often it is not possible to use a true experimental design in evaluating community-based programs, but there are a number of quasi-experimental designs available. Also, don't forget that it is often possible to use **existing data** to estimate program effects, as well. If you are looking at an ongoing program, or one that is based on a national model (such as the Parents As Teachers program), check to see if formal evaluations have already been done elsewhere. You may also be able to get useful information from the program's service statistics, or from local, state, or federal census data.
- **Step 4: Estimate the Monetary Value of Outcomes** - This is one of the most difficult and controversial aspects of conducting a cost-benefit analysis, and it may require the help of consultants. Some cost-savings are easier to estimate than others. For example, we may have data that the average cost of placing a child in residential treatment is \$20,000 a year, so if we are able to prevent 20 children from being placed in residential treatment, the estimated savings is  $20 \times \$20,000$ . However, other important outcomes may be much less obvious, and much harder to estimate.
- **Step 5: Account for the Effects of Time** - One of the trickiest and most technical aspects of cost-benefit analysis, especially for longitudinal studies that follow clients or outcomes over a period of years, is **discounting** of costs and calculating **rates of return** for alternative uses of the money (such as investing it). This includes taking into account the effects of inflation on the value of the dollar over time, or figuring the depreciation in the value of things like buildings and other capital equipment. Similar issues apply in estimating the value of benefits over a period of time. For example, if we want to look at the projected life-time earnings of a teenager who stays in school due to a drop-out prevention program compared to one who does not, we need to make projections about wages. If we want to look at whether the government will eventually recover its investment in the drop-out program through the taxes he or she will pay on the increased income, we need to make projections about future tax rates as well. These projections all require assumptions. Unless you or someone on the program staff has expertise in this area, it is strongly advised that you seek out a skilled consultant to help with this step.
- **Step 6: Aggregate and Apply a Decision Rule** - If you are looking at the costs and benefits on several outcomes (which is often the case), how will you decide which has priority? If a program for pregnant teenagers results in healthier babies (and lower hospital costs), but not in fewer repeat pregnancies, which outcome is more important?

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- **Step 7: Describe Distributional Consequences** - This is related to choosing your perspective of analysis. It involves specifying who gains and who loses under different conditions (because in some cases, one party's benefit is another party's loss). This may be a highly controversial and political step in the process.
- **Step 8: Conduct Sensitivity Analysis** - This step involves identifying the assumptions behind your cost estimates, and considering how critical they are to your calculations. If one of your assumptions turns out not to be accurate, or if conditions change during the time of your study (for example, the minimum wage goes up, affecting salary costs), will that change your whole conclusion, or is the effect strong enough that there is some leeway?
- **Step 9: Discuss the Qualitative Residual** - Since there are almost always some things that can't be quantified or given monetary values, it is important that your report include some discussion of these issues. A frank description of some of these qualitative issues in your report can help round out your conclusions, and reduce the chances of your study being used inappropriately.

### *Cost-benefit analysis is a term that refers both to:*

- A formal discipline used to help appraise, or assess, the case for a project or proposal, which itself is a process known as project appraisal; and
- An informal approach to making decisions of any kind.

Under both definitions the process involves, whether explicitly or implicitly, weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option. The formal process is often referred to as either CBA (Cost-Benefit Analysis) or BCA (Benefit-Cost Analysis). A hallmark of CBA is that all benefits and all costs are expressed in money terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their “present value.” Closely related, but slightly different, formal techniques include Cost-effectiveness analysis, Economic impact analysis, Fiscal impact analysis and Social Return on Investment (SROI) analysis. The latter builds upon the logic of cost-benefit analysis, but differs in that it is explicitly designed to inform the practical decision-making of enterprise managers and investors focused on optimizing their social and environmental impacts.

### **Theory**

Cost Benefit Analysis is typically used by governments to evaluate the desirability of a given intervention. The aim is to gauge the efficiency of the intervention relative to the status quo. The costs and benefits of the impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs - the value in their best alternative use. The guiding principle is to list all of the parties affected by an intervention, and place a monetary value of the effect it has on their welfare as it would be valued by them. The process involves monetary value of initial and ongoing expenses vs. expected return. Constructing plausible measures of the costs and benefits of specific actions is often very difficult. In practice, analysts try to estimate costs and benefits either by using survey methods or by drawing inferences from market behaviors. For example, a product manager may compare manufacturing and marketing expenses to projected sales for a proposed product, and only decide to produce it if he expects the revenues to eventually recoup the costs. Cost-benefit analysis attempts to put all relevant costs and benefits on a common temporal footing. A discount rate is chosen, which is then used to compute all relevant future costs and benefits in present-value terms. Most commonly, the discount rate used for present-value calculations is an interest rate taken from financial markets (R.H. Frank 2000). This can be very controversial - for example, a high discount rate implies a very low value on the welfare of future generations, which may have a huge impact on the

desirability of interventions to help the environment, and so on. Empirical studies have suggested that in reality, people's discount rates do decline over time. Because CBA aims to measure the public's true willingness to pay, this feature is typically built into studies. During cost-benefit analysis, monetary values may also be assigned to less tangible effects such as the various risks which could contribute to partial or total project failure; loss of reputation, market penetration, long-term enterprise strategy alignments, etc. This is especially true when governments use the technique, for instance to decide whether to introduce business regulation, build a new road or offer a new drug on the state healthcare. In this case, a value must be put on human life or the environment, often causing great controversy. The cost-benefit principle says, for example, that we should install a guardrail on a dangerous stretch of mountain road if the dollar cost of doing so is less than the implicit dollar value of the injuries, deaths, and property damage thus prevented (R.H. Frank 2000).

Cost-benefit calculations typically involve using time value of money formula. This is usually done by converting the future expected streams of costs and benefits to a present value amount.

### ***Key points***

(i) Cost/Benefit Analysis is a powerful, widely used and relatively easy tool for deciding whether to make a change. To use the tool, firstly work out how much the change will cost to make. Then calculate the benefit you will from it. Where costs or benefits are paid or received over time, work out the time it will take for the benefits to repay the costs. Cost/Benefit Analysis can be carried out using only financial costs and financial benefits. You may, however, decide to include intangible items within the analysis. As you must estimate a value for these, this inevitably brings an element of subjectivity into the process. Larger projects are evaluated using formal finance/capital budgeting, which takes into account many of the complexities involved with financial Decision Making. This is a complex area and is beyond the scope of this site. (ii) Whenever people decide whether the advantages of a particular action are likely to outweigh its drawbacks, they engage in a form of benefit-cost analysis (BCA). In the public arena, formal BCA is a sometimes controversial technique for thoroughly and consistently evaluating the pros and cons associated with prospective policy changes. Specifically, it is an attempt to identify and express in dollar terms all of the effects of proposed government policies or projects. While not intended to be the only basis for decision making, BCA can be a valuable aid to policymakers. (iii) Although conceived more than 150 years ago by the French engineer Jules Dupuit, BCA saw its first widespread use in the evaluation of federal water projects in the United States in the late 1930s. Since then, it has also been used to analyze policies affecting transportation, public health, criminal justice, DEFENSE, EDUCATION, and the environment. Because some of BCA's most important and controversial applications have been in environmental policy, this discussion of key issues in BCA is illustrated with examples from the environmental arena. (iii) To ascertain the net effect of a proposed policy change on social well-being, we must first have a way of measuring the gains to the gainers and the losses to the losers. Implicit in this statement is a central tenet of BCA: the effects of a policy change on society are no more or no less than the aggregate of the effects on the individuals who constitute society. Thus, if no individual would be made better off by a policy change, there are no benefits associated with it; nor are there costs if no one is made worse off. In other words, BCA counts no values other than those held by the individual members of society. (iv) It is equally important to note that benefits and costs, even though they are almost always expressed in dollar terms in BCA, go well beyond. (v) Changes in individuals' incomes. If someone's well-being is improved because of cleaner air—through improved visibility, for instance—he experiences a benefit even though his income may not change. Similarly, an increase in pollution that puts people at higher risk of disease imposes a cost on them even though their incomes may not fall. Indeed, a person would bear a cost (be made worse off) if the pollution posed a threat to an

exotic and little-known species of animal that he cared about. Some criticize BCA on the grounds that it supposedly enshrines the FREE MARKET and discourages government intervention. However, BCA exists precisely because economists recognize that free markets sometimes allocate resources inefficiently, causing problems such as dirty air and water. (vi) How, then, are benefits and costs estimated? While it is generally assumed that they are measured differently, benefits and costs are actually flip sides of the same coin. Benefits are measured by the willingness of individuals to pay for the outputs of the policy or project in question. The proper calculation of costs is the amount of compensation required to exactly offset negative consequences. Willingness to pay or compensation required should each be the dollar amount that would leave every individual just as well off following the implementation of the policy as before it.

**5. CONCLUSION** The goal of this primer has been to describe the major principles, concepts, and methods for doing economic analysis of highway projects. The coverage of these subjects has been necessarily brief. For the interested reader, a wealth of additional information is available from publicly accessible sources. The material in this primer, however, will hopefully be sufficient to provide a learning framework, and to make the reader aware of several key points. First and foremost, economic analysis provides valuable information to the planning, design, construction, preservation, and operation of the transportation infrastructure. The limited supply of transportation dollars must be invested in a manner that gives the greatest return to the public. The most objective way to accomplish this is to compare the benefits and costs of transportation projects through the standard unit of the discounted dollar over the life cycles of projects. As such, economic analysis is an integral component of any comprehensive infrastructure management methodology, such as Transportation Asset Management. Benefit-cost analysis is the most comprehensive method to evaluate the reasonableness of highway projects in economic terms. In some cases, when it is clear that a project must be undertaken regardless of its cost (e.g., a critical bridge on an interstate highway must be repaired or replaced in kind), LCCA will reveal the most cost-effective way of accomplishing the project. Used properly and in coordination with other disciplines, these methods can accommodate everything from user delay associated with work zones to measuring the net benefits of new roadway capacity. State agencies and other practitioners typically must invest some effort to establish the skills and procedures needed to conduct economic analysis. Once established, however, economic analysis integrates with existing planning, environmental, and engineering practices with minimal additional work. In fact, by directly addressing issues such as the effect of new highway capacity on traffic patterns or the justification for a project, economic analysis can considerably lessen agency workloads associated with designing projects to appropriate scale and demonstrating the need for such projects to the public. Uncertainty is a complicating factor in economic analysis as it is in virtually every area of human endeavor. Uncertainty can be measured and quantified as risk through risk analysis methods. Using economic analysis to evaluate the net benefits of various risk reduction strategies can help agencies manage risk. Finally, through the mechanism of the marketplace, the direct benefits and costs of highway projects will cause various indirect effects on local and regional economies, including impacts on employment levels, wages, business activity, and housing prices. EIA tools can measure these indirect effects of highway projects based on the findings of BCA. Indirect effects are often of major interest to decision makers and the public, and, particularly for large projects, can be presented in a complementary analysis to the BCA.

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